CpSc 875

John D. McGregor

Class 1

Overview

Why are you here?

http://www.sei.cmu.edu/newsitems/bestjobs2010.cfm

Syllabus

- Important consideration – this course meets at 8am 2 days a week – can you manage that?
- No textbook – we will use original sources
- Note the date of the final – do not make any other plans

- Questions?

Strategic Software Engineering Research Group

- We meet every Wednesday at 1pmin McAdams 226
- No, you might not understand anything the first few times you come but you will learn
- No need to register
- We currently are investigating software ecosystems
- We learn by doing and publishing
- New PhD students without a home are particularly welcome

Tools

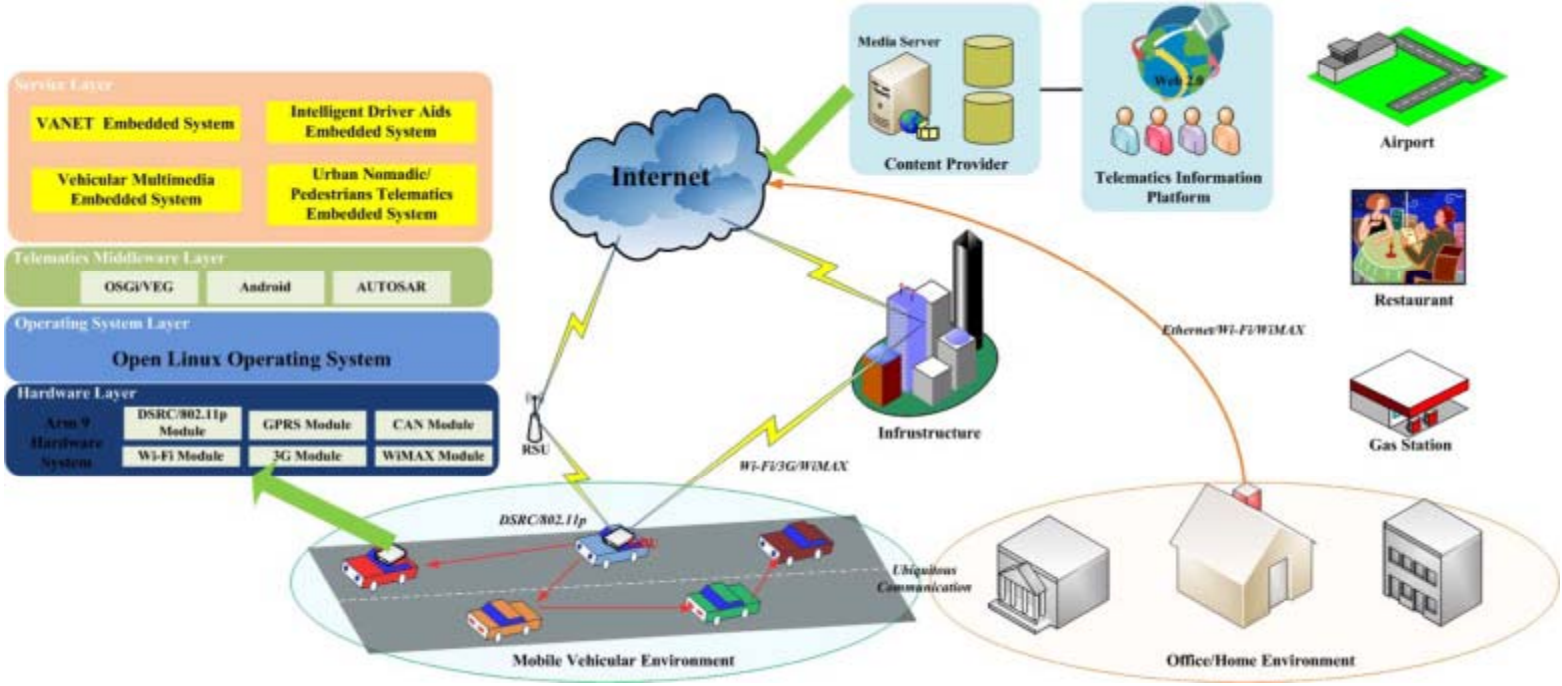
- OSATE
  - http://gforge.enseeiht.fr/projects/osate2/
- Topcased
  - www.topcased.org
- Xmind
  - http://www.xmind.net
- Tina
  - http://projects.laas.fr/tina//
- Ocarina
  - http://penelope.enst.fr/aadl/wiki/OcarinaPresentation
  - Ocarina Eclipse plug-in: http://penelope.enst.fr/aadl/wiki/OcarinaPlugInPresentation
- AADL-BA
  - http://penelope.enst.fr/aadl/wiki/BAFEInstallationUpdateSite
- Have the first three running by next class

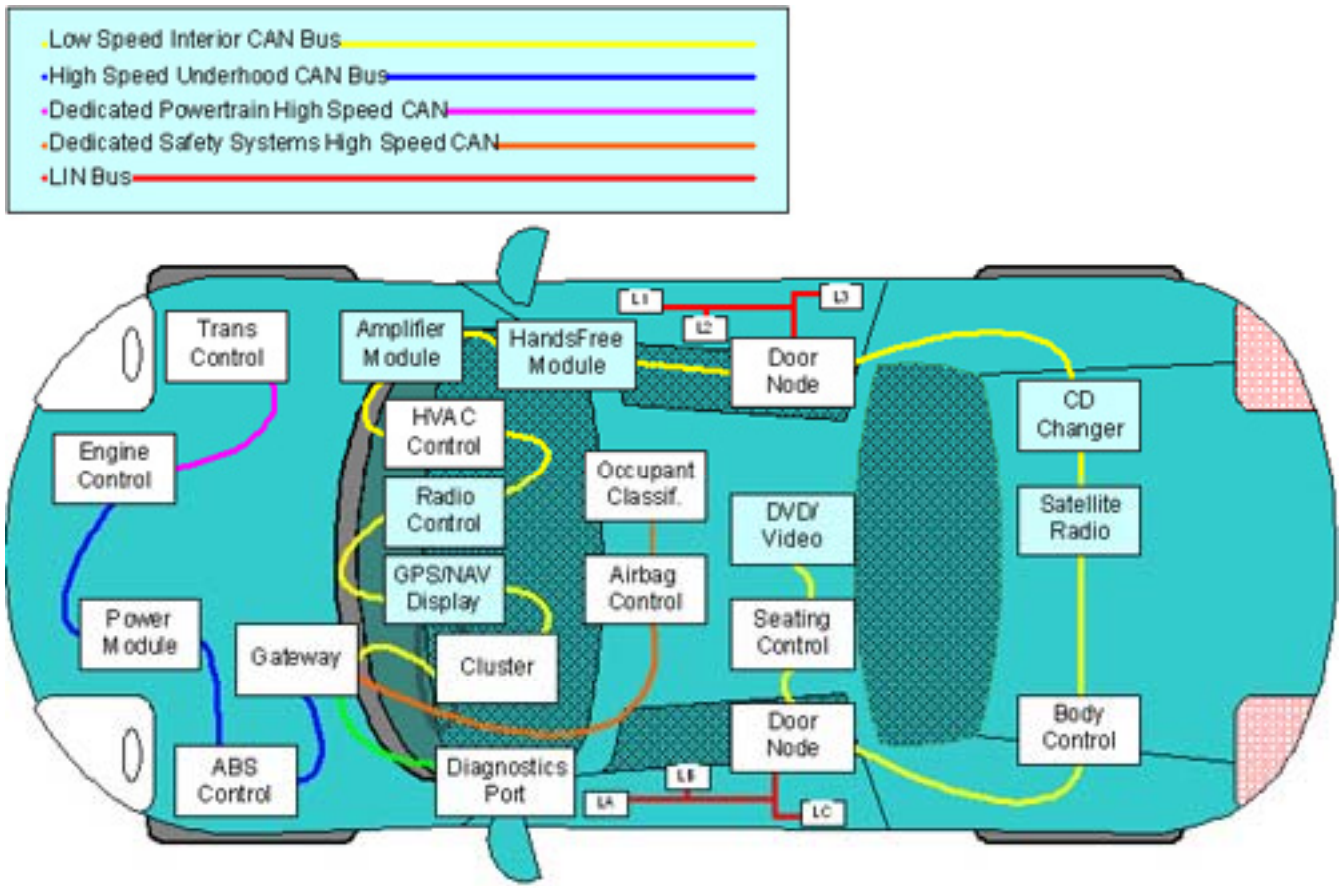
Tutorials that may help with any problems in operating the tools

- /home/johnmc/public_html/courses/syse802/resources/winks/initializing.htm
- /home/johnmc/public_html/courses/syse802/resources/winks/topcasedInitialized.htm
- /home/johnmc/public_html/courses/syse802/resources/winks/extends.htm
- /home/johnmc/public_html/courses/syse802/resources/winks/contributes.htm
- /home/johnmc/public_html/courses/syse802/resources/winks/comparison.htm
- /home/johnmc/public_html/courses/syse802/resources/winks/aadlProject.htm
- All tools' urls have info on how to use

Continuing example: Telematics systems

- http://homepages.ipact.nl/~jverlinden/eadis/docs/Telematics_map_presentation3june2008.pdf




Low Speed Interior CAN Bus
High Speed Underhood CAN Bus
Dedicated Powertrain High Speed CAN
Dedicated Safety Systems High Speed CAN
LIN Bus
Trans Control
Amplifier Module
HandsFree Module
L1
L2
L3
Door Node
CD Changer
HVAC Control
Engine Control
Occupant Classif.
Radio Control
DVD/ Video
Satellite Radio
GPS/NAV Display
Airbag Control
Power Module
Seating Control
Gateway
Cluster
Body Control
Door Node
ABS Control
Diagnostics Port
L4
L5
L6

Motivation

- UPS 2010

  Drivers in telematics-equipped vehicles achieved twice as much improvement as other drivers in stops per mile (a metric that measures our ability to deliver more packages with fewer engine restarts that consume fuel). Telematics saved 1.7 million miles of driving in 2010, equating to more than 183,000 gallons of fuel or 1,857 metric tonnes of CO2. Applying this same rate of improvement across the domestic package car fleet would yield savings for the year of 9,256,000 miles or 974,000 gallons of fuel (9,890 metric tonnes of CO_2).

Toyota Safety Connect

BMW iPhone App

Continuing Example

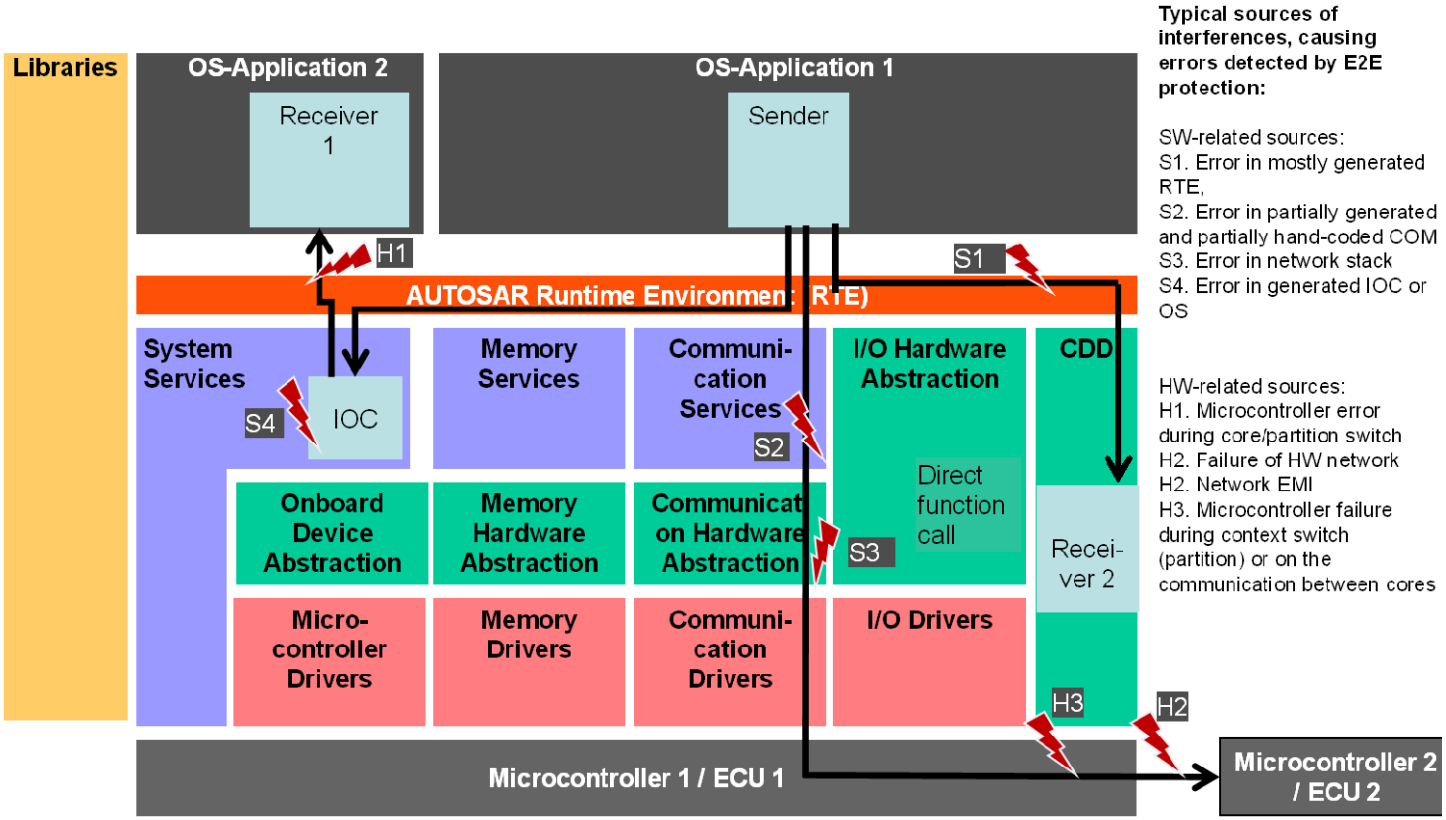
- The exercises in this course will use vehicle telematics as the continuing example.
- We will focus on in-vehicle telematics but we will consider the entire telematics system including
  - Car to car
  - Car to base
  - Car to cell tower, etc.

Readings in domain

- http://www.springer.com/978-0-387-75104-7
- http://gallery.mailchimp.com/e68b454409061ef6bb1540e01/files/Embedded_Telematics_in_the_Automotive_Industry_sw_iS.pdf
- http://www.edmunds.com/car-technology/car-tech-101-telematics-system-basics.html
- http://ece-dept-43.unh.edu/Project54/Research/Technical%20Reports/Vehicle%20Telmatics.pdf – literature review through 2007

Autosar

- Standard architecture



Definition

- The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them.

Software Architecture in Practice (2nd edition), Bass, Clements, Kazman; Addison-Wesley 2003

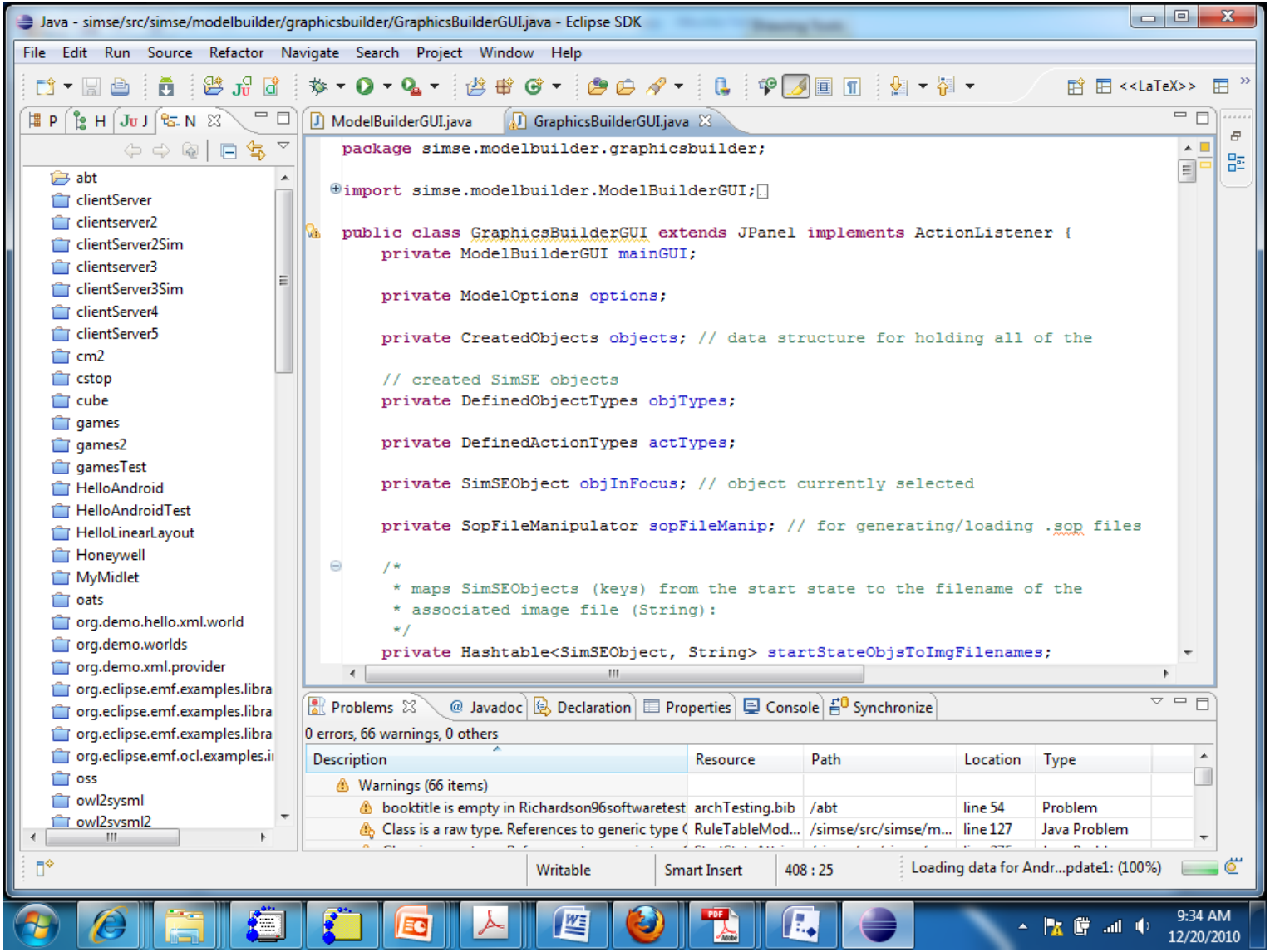
Course Threads

- Designing the architecture
  - A process
  - Techniques
- Communicating the architecture
  - Notations
  - Content
- Adding business value

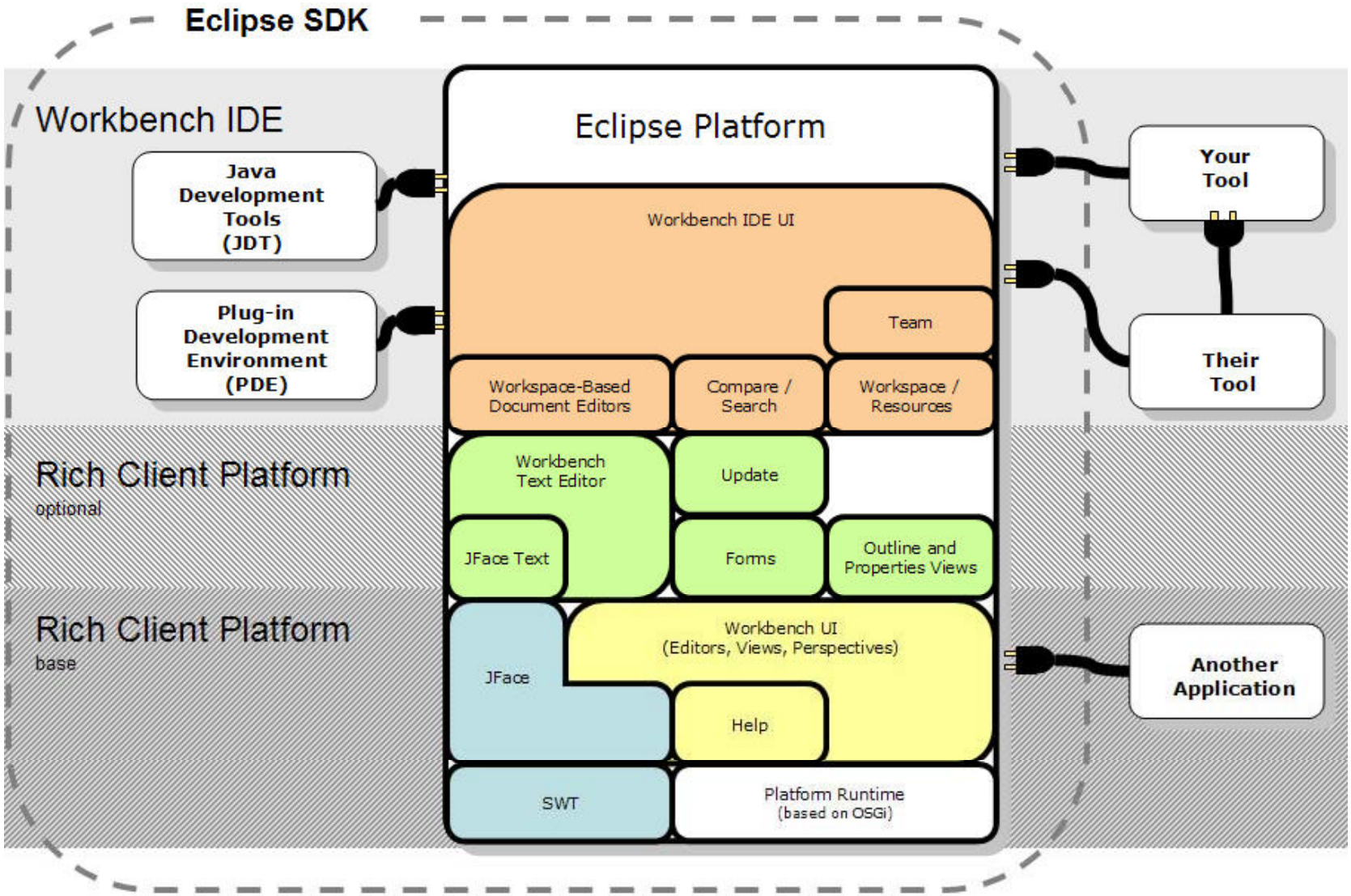
Starting the process

- Don’t just start digging the foundation
- Few “green field” projects
- Have some domain experience and architectural background
- http://www.qnx.com/solutions/industries/automotive/

Eclipse


Java - simse/src/simse/modelbuilder/graphicsbuilder/GraphicsBuilderGUI.java - Eclipse SDK
File Edit Run Source Refactor Navigate Search Project Window Help
ModelBuilderGUI.java
GraphicsBuilderGUI.java
package simse.modelbuilder.graphicsbuilder;
import simse.modelbuilder.ModelBuilderGUI;
public class GraphicsBuilderGUI extends JPanel implements ActionListener {
private ModelBuilderGUI mainGUI;
private ModelOptions options;
private CreatedObjects objects; // data structure for holding all of the
// created SimSE objects
private DefinedObjectTypes objTypes;
private DefinedActionTypes actTypes;
private SimSEObject objInFocus; // object currently selected
private SopFileManipulator sopFileManip; // for generating/loading .sop files
/*
* maps SimSEObjects (keys) from the start state to the filename of the
* associated image file (String):
*/
private Hashtable<SimSEObject, String> startStateObjsToImgFilenames;
Problems
Javadoc
Declaration
Properties
Console
Synchronize
0 errors, 66 warnings, 0 others
Description
Resource
Path
Location
Type
Warnings (66 items)
booktitle is empty in Richardson96softwaretest
archTesting.bib
/abt
line 54
Problem
Class is a raw type. References to generic type
RuleTableMod...
/simse/src/simse/m...
line 127
Java Problem
Writable
Smart Insert
408 : 25
Loading data for Andr...pdate1: (100%)
9:34 AM
12/20/2010

Eclipse architecture cartoon



Pieces

- Modules, subsystems, …
- These are pieces of a system and entities with which the architect works.
- Determining what a particular module does is the job of the architect
- How a particular module does its assigned job is a detailed design issue not an architecture issue
- Architectural issues cross module boundaries

Orchestration/choreography

- The architect creates pieces for certain reasons
- And connects certain pieces to achieve specific objectives.
- The architect orchestrates the interactions of the pieces of the system but leaves the details to the engineers.

System/software

- A system is the complete package needed to solve a problem. It will usually include:
  - Hardware – stand-alone computer; an electronic controller embedded in an assembly such as a brake assembly; an integrated multi-function device such as a cell-phone
  - Software – an operating system or an end-user application
- Some people even include the users and other non-computing elements as part of the system

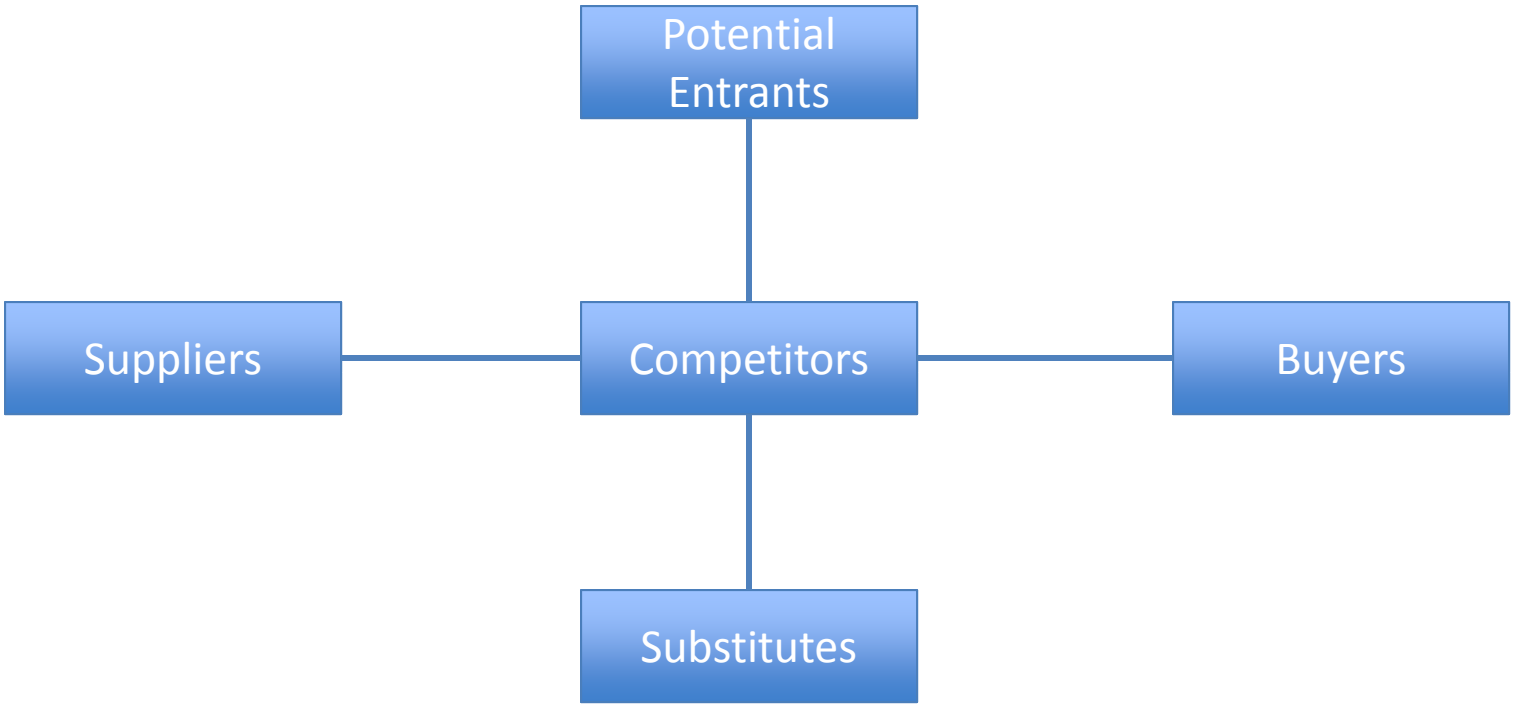
Stakeholders

- A stakeholder is any person with an interest in the system.
- We will listen harder to some stakeholders than others.
- In our techniques often we will give stakeholders differing numbers of votes based on their priority.
- The architect is a diplomat but also a dictator.

Business Goals

- The goals of the business must be reflected in the architecture of its software-intensive products.
- Business strategy is used to set the business goals and influence the architecture.
- Do you want to dominate the market? Become part of a community? Be the center of that community?

Porter's 5 Forces Strategy Development Technique



Strategy/architecture

- Today many products are designed to work with other products. For example, our infotainment system will allow cell phones, ipods, etc. to be connected to our product.
- Our strategy is to
  - establish an ecosystem of companies that work with auto OEMs.
  - expand our market by accommodating a variety of technologies.
  - Ride the crest of the wave of change in vehicles
- Our architecture will be a domain-specific architecture that emphasizes
  - Light weight, small footprint hardware
  - Flexible, and
  - Easily modified software.

Platform

- This term has many meanings.
- Some people see it as
  - an operating system
  - An operating system and processor instruction set
  - But it may be a software platform.
- Essentially a “platform” is a dividing line below/ beyond which we have no control.
- A product may be intended for many platforms but each will have some unique characteristics.

Platform - 2

- Microsoft windows/Intel-compatible processor is considered a platform
- The software architect has to understand the characteristics of the platform.
- In organizations that manufacture platforms, the software architect may be part of an architecture team that covers both hardware and software.

Ecosystem

- A platform is often the basis for an ecosystem.
- An ecosystem is a group of systems or companies that enhance or degrade each other.
- There may be several accounting packages all within the same ecosystem.
- A company may deploy their products in multiple ecosystems with different sets of features.

Ecosystem - 2

- An ecosystem encompasses a wide range of types of companies and every member of the ecosystem is a stakeholder (although of varying priorities).
- The ecosystem can control directions of the marketplace if it is sufficiently large and influential

- http://advice.cio.com/thomas_wailgum/11248/apples_ipad_ecosystem_suppliers_and_developers_hard_at_work

Requirements

- This is not a course on requirements but they are a necessary input into the architecting process
- We will use a use case-based approach.
- A use case is a description of an actual “use” of the system to be developed.
- An actor is the source of the stimulus from outside the system.
- The use is a set of stimulus/response pairs.
- There are relationships between uses: extends, generalizes, includes.

Functional requirements

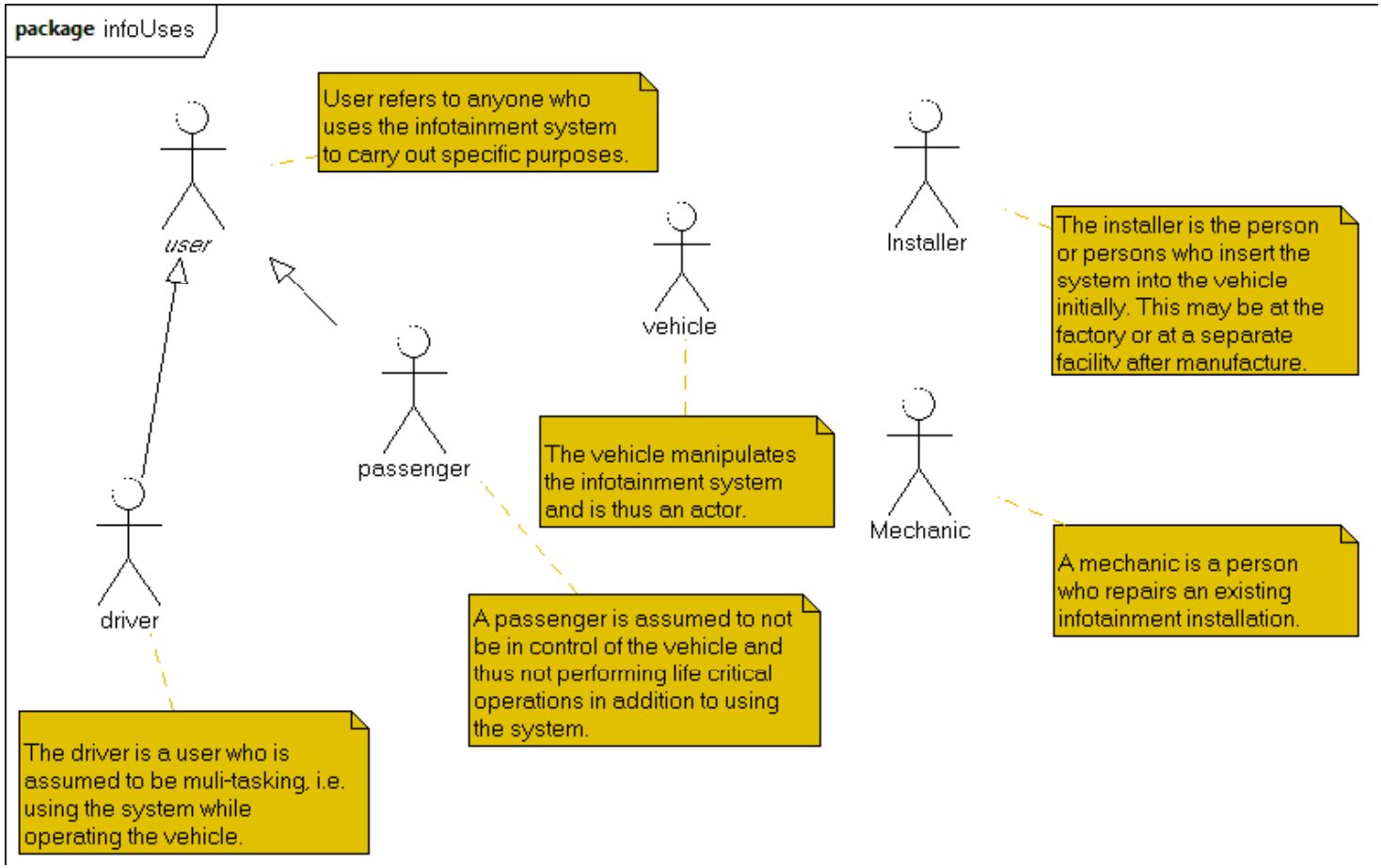
- These are the things that the system must be able to do:
  - Example: The brake system reduces the velocity of the vehicle
- Typically 80% of project problems are related to the requirements

Non-functional requirements

- “How” a functional requirement is carried out
  - How fast must it be carried out
  - How reliably
- A quality attribute is a characteristic of a piece of software
- A non-functional requirement sets a bound on the value of a quality attribute for the system under design
- “The addition of a new feature must be done in 5 days or less” – non-functional requirement on the modifiability quality attribute
- “The velocity of the vehicle must be reduced to zero within seconds” – stopability quality attribute
- A quality attribute is sometimes termed an “ility”

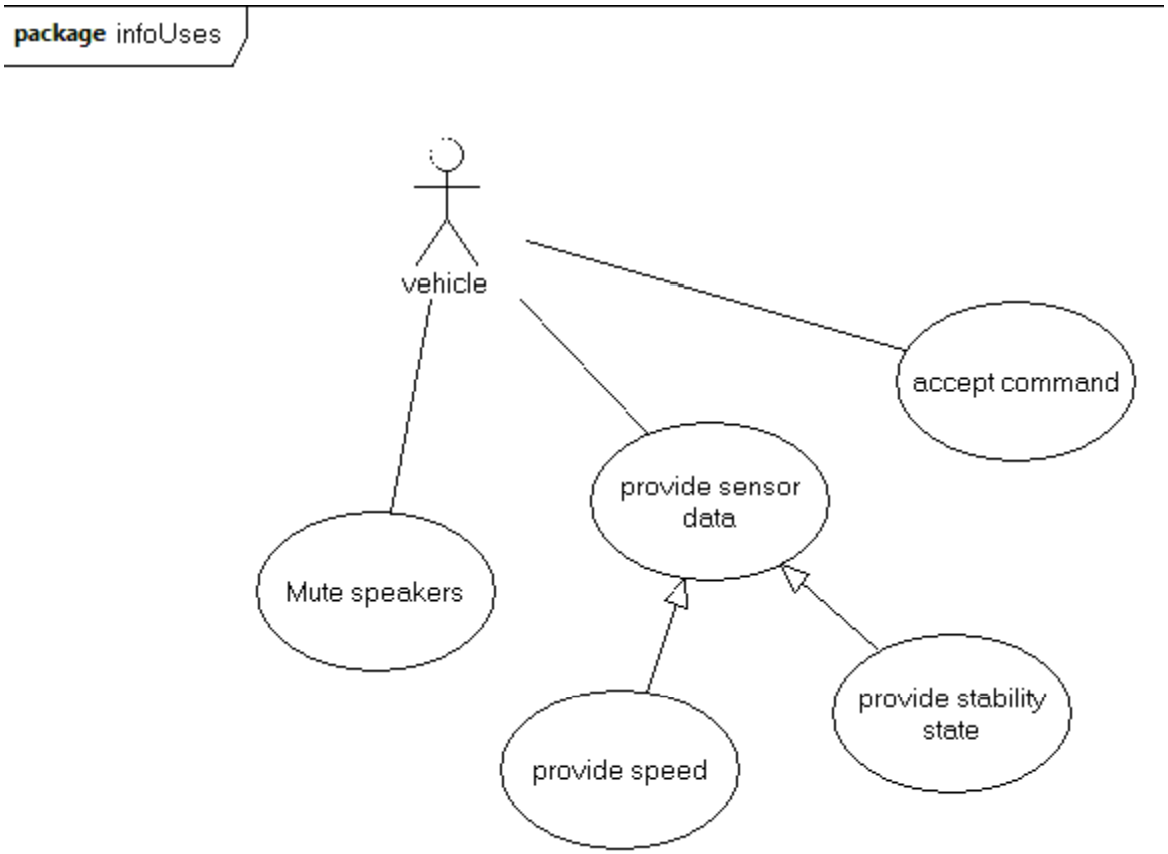
Use case diagram

- Actor is a stimulus from outside the system



Use case diagram - 2

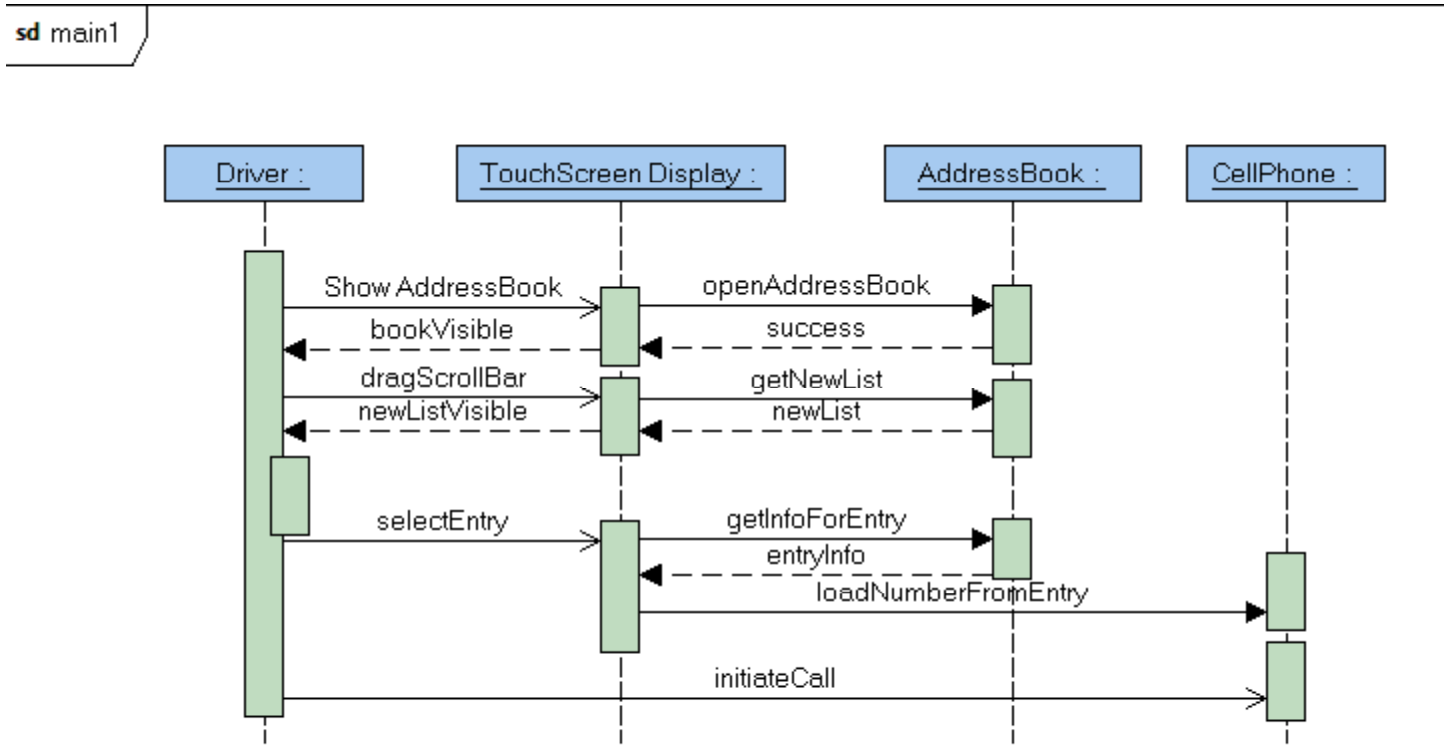
- Use case is a single use of the system triggered by an actor.
- Association relates an actor to a use
- Extends relates a use to a use by adding on.
- Generalizes relates a use to a use by resolving abstractions.



Reference: *www-edlab.cs.umass.edu/cs520/OMG-**Tutorial**s/Tut2BehaviorModeling.ppt*

Sequence Diagram

- Shows the sequence of interactions.
- Each “life line” – the vertical line – is the life of an object – an instance of a class.
- Closed arrows are synchronous and open arrows are asynchronous messages.



Interface

- Defines the public methods (functions) that a module supports and that others, with which it is associated, may use.
- An architecture defines modules and their interfaces and determines which modules should be associated.

Object Constraint Language (OCL)

- Language used in models to specify constraints

Context GPS

inv: GPSCoordinates.degrees>=0 and GPSCoordinates.degrees<=90

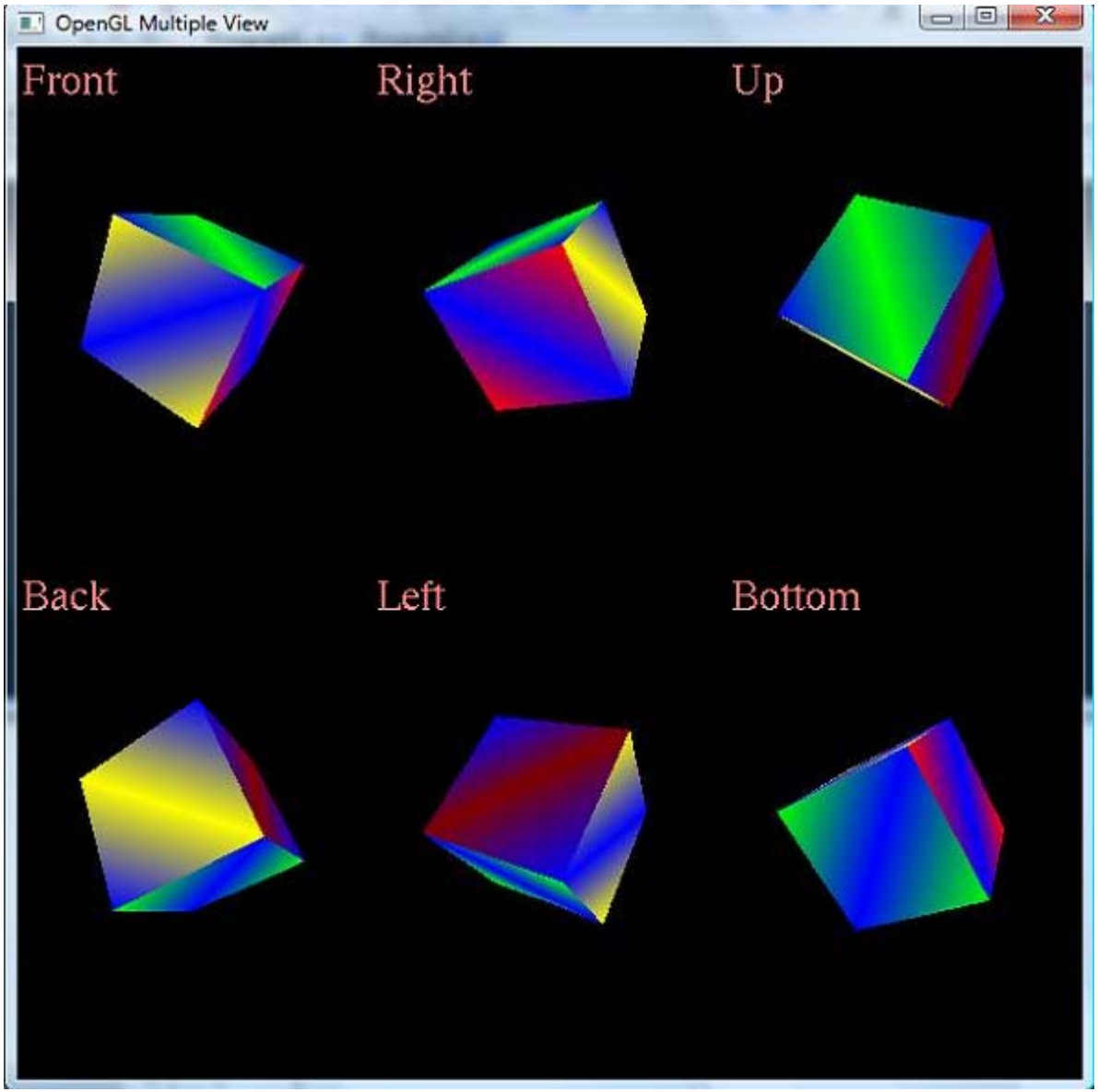
inv: GPSCoordinates.minutes>=0 and GPSCoordinates.minutes<=60

inv: GPSCoordinates.seconds>=0 and GPSCoordinates.seconds<=60

http://www.uni-koblenz.de/~beckert/Lehre/Verification/10OCL.pdf

Views

- Different ways of looking at the same thing.



One entity, 3 views - 1

One entity, 3 views - 2

One entity, 3 views - 3

One entity, 3 views

Who cares?

Copied from http://www.appbrain.com/app/angry-birds/com.rovio.angrybirds

When it absolutely, positively has to work…

- Fully Autonomous Digital Engine Controller (FADEC)
- One on every jet engine
- The pilot cannot override the software running in the FADEC.
- A two engine jet has two of these. The reliability is $R_f * R_f$
- At Rf=.999 the reliability of the two together is .998

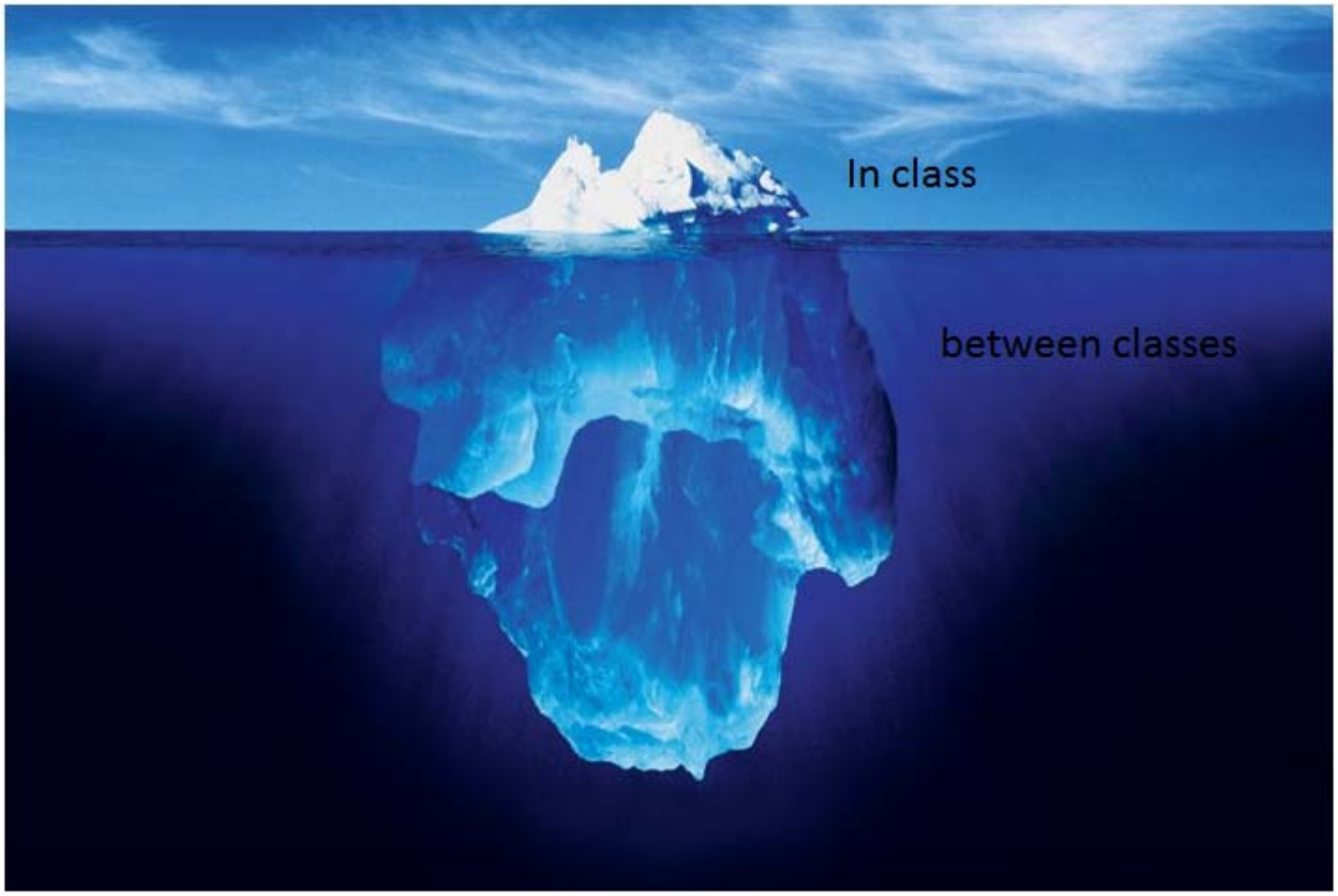
Context

- This semester we will be thinking about software that matters, software that has to work every time or someone dies or loses their life savings
- We will use elements of craftsmanship, creativity, and manufacturing
- We will blend business and technical concerns

Reading – original sources

- Creating
  - http://www.sei.cmu.edu/reports/06tr023.pdf
  - http://www.sei.cmu.edu/reports/07tr005.pdf
- Communicating
  - http://www.sei.cmu.edu/architecture/tools/viewsandbeyond/index.cfm
  - http://www.sei.cmu.edu/reports/05tn017.pdf

How we work



Action list for next class

- Install and test the required software
  - Email a screen shot of the user interface of each of the three systems to johnmc@clemson.edu by 11:59pm 1/14/2013; place all in a zip file
- Read the first tech report on the previous list
- Read the first resource for the telematics example
- Get enough sleep to last the entire semester